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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/710,218	11/10/2000	Timothy L. Harris	1004-4896	4731

22120 7590 10/20/2003

ZAGORIN O'BRIEN & GRAHAM LLP  
401 W 15TH STREET  
SUITE 870  
AUSTIN, TX 78701

EXAMINER
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ZHEN, LI B

ART UNIT	PAPER NUMBER
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2126

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DATE MAILED: 10/20/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/710,218

Applicant(s)

HARRIS, TIMOTHY L.

Examiner

Li B. Zhen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-29 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_.
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3. 6) ☐ Other:

## DETAILED ACTION

### *Specification*

1. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

### *Claim Rejections - 35 USC § 103*

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1 – 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over “Lock-Free Linked Lists Using Compare-and-Swap” (hereinafter Valois) in view of U.S. Patent No. 5,765,175 to Needham.

As to claim 1, Valois teaches a non-blocking concurrent shared object representation [data structures that implement a non-blocking singly-linked list; p. 214, right col., 2<sup>nd</sup> paragraph]:

a linked-list of nodes [cells] encoding of a group of zero or more values [singly-linked list data structure consists of a collection of cells, each representing an item in the list; p. 215, left col., 4<sup>th</sup> paragraph]; and

linearizable operations defined [TEST&SET and FETCH&ADD...atomically read and modify the value of a shared memory location; p. 215, right col., 1<sup>st</sup> paragraph] to

implement insert [adding new cells; p. 216, right col., 7<sup>th</sup> full paragraph] and remove operations on the group [deletion of the cell from the list; p. 217, right col., 3<sup>rd</sup> full paragraph]. Valois teaches writing to the back\_link field of the node when the node is deleted [p. 217, right col., 4<sup>th</sup> full paragraph] but does not specifically teach marking the node to indicate logical deletion of the correspond node.

However, Needham teaches a marked node indication [delete flag] signifying logical deletion of a corresponding one of the values from the group [delete flag is a flag which identifies that the file identified by the current node is deleted; col. 3, lines 3 – 25].

It would have been obvious to a person of ordinarily skilled in the art at the time of the invention to apply the teaching of a marked node indication signifying logical deletion of the node as taught by Needham to invention of Valois because this would identify the nodes in the list that need to be physically removed so that the memory of the deleted nodes can be reclaimed and reused.

As to claim 2, Valois as modified teaches physically excise the node corresponding to the logically deleted value [removing the sequence of deleted and replaced nodes from the linked list; col. 3, lines 50 – 65 of Needham].

As to claim 16, this is a combination of claims 1 and 2, see the rejections to claims 1 and 2 above.

As to claim 25, this is a product claim that corresponds to claim 1; note the rejection to claim above, which also meets this product claim.

As to claim 29, this is an apparatus claim that corresponds to method claim 16; see the rejection to claim 16 above, which also meets this apparatus claim. As to the

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additional limitations, Valois teaches plural processors [implemented on uniprocessors using the technique of atomic restartable sequences; p. 215, right col., 2<sup>nd</sup> paragraph], one or more data stores [dictionaries; p. 218, Section 4], and means for traversing the encoded group without use of an atomic operation [traversal of the list data structure; p. 216, right col., 6<sup>th</sup> paragraph].

As to claims 3 and 21, Valois as modified teaches compare and swap (CAS) operations [COMPARE&SWAP as main synchronization primitive; p. 215, left col., last paragraph of Valois].

As to claim 4, Valois as modified teaches reclamation of storage associated with the excised node is independent of the linearizable operations [ALLOC removes a free cell from the set... and RECLAIM returns a cell no longer being used to the set of free cells; p. 221, left col., 1<sup>st</sup> full paragraph of Valois].

As to claim 5, Valois as modified teaches the linked-list of nodes is free of reference count storage for coordination of garbage collection [node includes a plurality of parameters such as a next pointer, a replace pointer, a delete flag and file identification information; column 3, lines 3 – 25 of Needham]. The nodes do not include a reference count field.

As to claim 6, Valois as modified teaches traversal of the concurrent shared object is without atomic update of a garbage collection coordination store [traversal of the list data structure; p. 216, right col., 6<sup>th</sup> paragraph of Valois].

As to claim 7, Valois as modified teaches successful completion of an insertion into the group requires, at most, one atomic update of the concurrent shared object

[insert the new cell and auxiliary node at the position specified by the cursor, returning the value TRUE if successful; p. 216, right col., last paragraph – p. 217, right col., first paragraph of Valois], successful completion of a deletion from the group requires, at most, two atomic updates of the concurrent shared object [FIINDFROM algorithm is used to locate the position of the cell containing the given key, and the TRYDELETE algorithm is used to delete cell; p. 219, left col., 1<sup>st</sup> full paragraph of Valois], and traversal of the concurrent shared object is without atomic update of the concurrent shared object [traversal of the list data structure; p. 216, right col., 6<sup>th</sup> paragraph of Valois].

As to claim 8, see the rejection to claims 17, 19 and 20.

As to claim 9, Valois modified teaches linearizable operations further implement semantics of a find operation [FIINDFROM algorithm is used to locate the position of the cell containing the given key; p. 219, left col., 1<sup>st</sup> full paragraph of Valois].

As to claim 10, Valois as modified teaches the values of the group are stored in respective ones of the nodes [singly-linked list data structure consists of a collection of cells, each representing an item in the list; p. 215, left col., 4<sup>th</sup> paragraph of Valois].

As to claims 11 and 12, Valois as modified teaches the values of the group are represented in storage identified by respective ones of the nodes [replacement pointer, when set to a value, points to a node which replaces the current node; col. 3, lines 3 – 25 of Needham].

As to claim 13, Valois as modified teaches the marked node indication includes a distinguishing pointer value [node includes a plurality of parameters such as a next

pointer, a replace pointer, a delete flag and file identification information; column 3, lines 3 – 25 of Needham].

As to claim 14, Valois as modified teaches the marked node indication includes a distinguishing bit value [flag] in an otherwise unused portion of a next node pointer of the logically deleted node [delete flag is a flag which identifies that the file identified by the current node is deleted; col. 3, lines 3 – 25 of Needham].

As to claim 15, Valois as modified teaches respective next node pointers of those of the nodes corresponding to current values of the group directly reference respective other ones of the nodes [field next, which contains a pointer to the cell occupying the next position in the list; p. 215, Section 2.1 of Valois], and the marked node indication includes a distinguishing additional level of indirection between the next node pointer of the logically deleted node and a respective other one of the nodes [when a cell is deleted from the list, the pre\_cell field of the cursor is copied into the cell's back\_link field; p. 217, right col. 4<sup>th</sup> full paragraph of Valois].

As to claim 17, see the rejection to claim 1 above.

As 18, Valois as modified teaches the logical deletion is performed as part of a deletion operation operating upon the value [delete flag is a flag which identifies that the file identified by the current node is deleted; col. 3, lines 3 – 25 of Needham], and the marked node excision is performed as part of another operation [removing the sequence of deleted and replaced nodes from the linked list; col. 3, lines 50 – 65 of Needham].

As to claim 19, Valois as modified teaches the another operation is an insert operation [node 2 805, itself a replacement node, is replaced by the addition of node 810, Fig. 8; col. 5, lines 55 – 67 of Needham].

As to claim 20, Valois as modified teaches the another operation is a remove operation operating upon another node [removing the sequence of deleted and replaced nodes from the linked list; col. 3, lines 50 – 65 of Needham].

As to claim 22, Valois as modified teaches after the logical deletion but before the marked node excision, traversing, as part of an access operation, the linked-list including the marked node [deleted cells could be left intact for cursors to continue traversing them; p. 220, Section 5 of Valois].

As to claims 23 and 24, Valois as modified teaches the ordered set is organized in increasing value order [abstract concept of a list is a collection of items which have a linear order; p. 215, left col., 4<sup>th</sup> full paragraph of Valois], and the remove operation is selective for a value, if any, of the group greater than or equal to the specified value [FIINDFROM algorithm is used to locate the position of the cell containing the given key, and the TRYDELETE algorithm is used to delete cell; p. 219, left col., 1<sup>st</sup> full paragraph of Valois].

As to claims 26 and 27, see the rejection to claim 1 above.

As to claim 28, Valois as modified teaches at least one computer readable medium is selected from the set of a disk, tape or other magnetic, optical, or electronic storage medium [memory such as system RAM 322 and erase-slowly media flash array



334; col. 2, line 60 – col. 3, line 3 of Needham] and a network, wireline, wireless or other communications medium.

***Conclusion***

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

U.S. Patent No. 5,081,572 to Arnold teaches using memory access serialization instructions to allow multiple processes to add and remove elements from a list.

U.S. Patent No. 6,581,063 to Kirkman teaches a method and apparatus for maintaining a linked list.

U.S. Patent No. 4,584,640 to MacGregor teaches a system containing linked lists that can add and delete items from the lists while maintaining the integrity of the linked nature of the lists.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Li B. Zhen whose telephone number is (703) 305-3406. The examiner can normally be reached on Mon - Fri, 8am - 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John A. Follansbee can be reached on (703) 305-8498. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

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Li B. Zhen  
Examiner  
Art Unit 2126

lbz  
September 26, 2003

A handwritten signature in black ink, appearing to be 'JF', written in a cursive style.

JOHN FOLLANSBEE  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2100